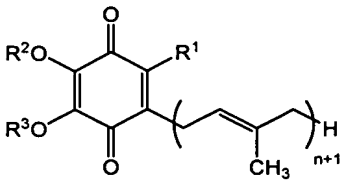
WHAT IS CLAIMED IS:

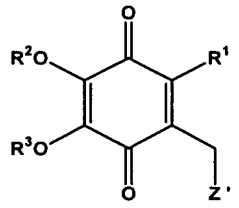
1. A method of preparing a compound of Formula



(III),

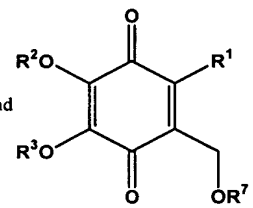
said method comprising:

contacting a compound that is a member selected from:



VII a

and



XXIV

in which

R^1, R^2 and R^3 are independently selected from substituted or unsubstituted C_1-C_6 alkyl groups;

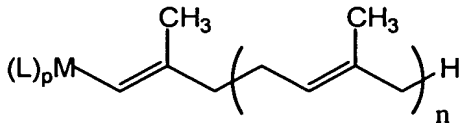
R^7 is selected from H, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted aryl, substituted or unsubstituted heteroaryl, substituted or unsubstituted heterocycloalkyl, SOR^9, SO_2R^9, $C(O)R^9$, $C(O)OR^9$, $P(O)OR^9OR^{10}$, $P(O)N(R^9)_2(R^{10})_2$, and $P(O)R^9R^{10}$

wherein

each R^9 and R^{10} is a member independently selected from substituted or unsubstituted alkyl, substituted or unsubstituted aryl, substituted or unsubstituted heteroaryl and substituted or unsubstituted heterocycloalkyl; and

Z' is a leaving group other than halogen,

with a compound having the structure



(IV)

wherein

each L is independently selected from substituted or unsubstituted alkyl, alkoxy, aryl or aryloxy with 1 to 10 carbon atoms;

M is aluminum;

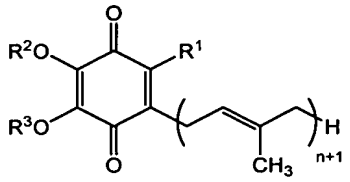
p is 1 or 2

n is an integer from 0 to 19,

in the presence of a coupling catalyst effective at catalyzing coupling between the methylene carbon of the quinone of Formula (VII) a or (XXIV) and the vinylic carbon attached to M,

thus preparing said compound of Formula (III).

2. A method of preparing a compound having the formula:



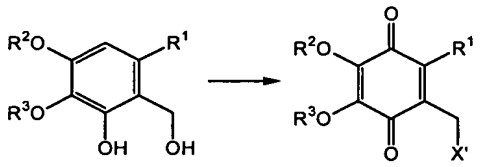
(III)

wherein

R^1, R^2 and R^3 are members independently selected from substituted or unsubstituted C_1-C_6 alkyl groups; and

n is an integer from 0 to 19, said method comprising:

(a) performing the transformation:

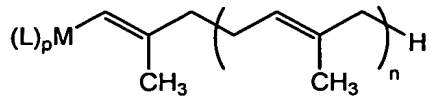


(XXVII) (XXVIII)

wherein

X' is OH or a leaving group; and

(b) contacting the product of (a) with:



(IV)

wherein

each L is independently selected from substituted or unsubstituted alkyl, alkoxy, aryl or aryloxy with 1 to 10 carbon atoms;

M is aluminum;

n is an integer from 0 to 19;

p is 1 or 2;

in the presence of a coupling catalyst effective at catalyzing coupling between the methylene carbon of the quinone of Formula XXVIII and the vinylic carbon attached to M in Formula (IV)

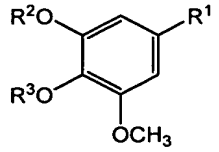
thus preparing said compound of Formula (III).

3. The method according to claim **1** or **2**, wherein R^1, R^2 and R^3 are methyl.

4. The method according to claim **1** or **2**, wherein L is methyl.

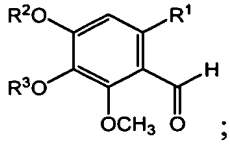
5. The method according to claim **2**, further comprising, prior to step (a):

(c) formylating the compound:



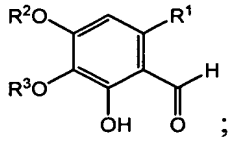
(XXX)

forming:



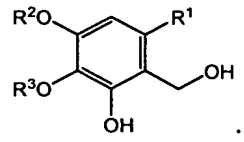
; **(XXXI)**

(d) demethylating the product of (c), forming:



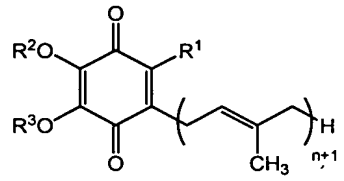
; and **(XXXII)**

(e) reducing the product of (d), forming:



(XXXIV)

6. A method of preparing a compound having the formula:



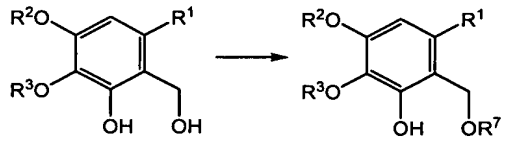
(III)

wherein

R^1, R^2 and R^3 are members independently selected from substituted or unsubstituted C_1-C_6 alkyl groups; and

n is an integer from 0 to 19, said method comprising:

(a) performing the transformation:



(XXVII) (XXXV)

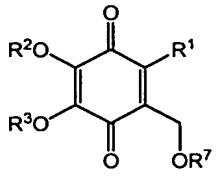
wherein

R^1, R^2 and R^3 are members independently selected from substituted or unsubstituted C_1-C_6 alkyl groups; and

R^7 is selected from H, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted aryl, substituted or unsubstituted heteroaryl, substituted or unsubstituted heterocycloalkyl, SOR^9, SO_2R^9, $C(O)R^9$, $C(O)OR^9$, $P(O)OR^9OR^{10}$, $P(O)N(R^9)_2(R^{10})_2$, and $P(O)R^9R^{10}$

wherein each R^9 and R^{10} is a member independently selected from substituted or unsubstituted alkyl, substituted or unsubstituted aryl, substituted or unsubstituted heteroaryl and substituted or unsubstituted heterocycloalkyl; and

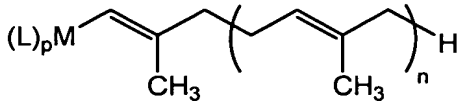
(b) oxidizing the product of (a) to a compound having the formula:



(XXIV);

and

(c) contacting the product of (b) with:



(IV)

wherein

each L is independently selected from substituted or unsubstituted alkyl, alkoxy, aryl or aryloxy with 1 to 10 carbon atoms;

M is aluminum;

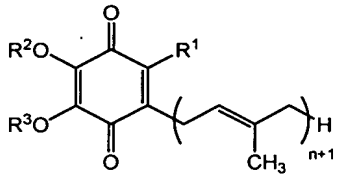
p is 1 or 2;

n is an integer from 0 to 19

in the presence of a coupling catalyst effective at catalyzing coupling between the quinone methylene carbon of the compound of Formula (XXIV) and the vinylic carbon attached to M,

thus preparing said compound of Formula (III).

7. A method of preparing a compound having the formula:



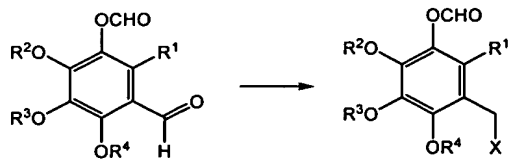
(III)

wherein

R^1, R^2 and R^3 are members independently selected from substituted or unsubstituted C_1-C_6 alkyl groups; and

n is an integer from 0 to 19, said method comprising:

(a) performing the transformation:



(XXIII) (XXXVI) ;

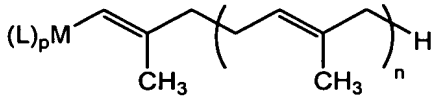
wherein

R^1, R^2 and R^3 are independently selected from substituted or unsubstituted C_1-C_6 alkyl groups;

R^4 is a member selected from hydrogen, substituted or unsubstituted alkyl, and protecting groups; and

X is a leaving group;

(b) contacting the product of (a) with:



(IV)

wherein

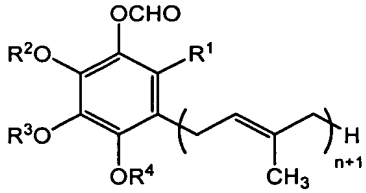
each L is independently selected from substituted or unsubstituted alkyl, alkoxy, aryl or aryloxy with 1 to 10 carbon atoms;

M is aluminum;

p is 1 or 2;

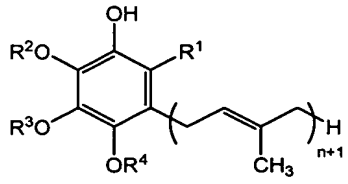
n is an integer from 0 to 19

in the presence of a coupling catalyst effective at catalyzing coupling between the substituted methylene carbon atom of the compound of Formula (XXXVI) and the vinylic carbon attached to M, forming:



(XXXVII)

(c) deprotecting the product of (b), forming:



(XXXVIII); and

(d) oxidizing the product of (c),

thus forming said compound of Formula (III).

8. The method according to claim **1**, **2**, **6** or **7**, wherein said coupling catalyst comprises a transition metal.

9. The method according to claim **8**, wherein said transition metal is Ni(0).

10. A method of carboaluminating an alkyne substrate, forming a species with an alkyl moiety bound to aluminium, said method comprising:

(a) contacting said alkyne substrate with $(L)_{p+1}M$ and x molar equivalents of water or $R^{20}OH$, or, when each L is methyl, with x molar equivalents of water, $R^{20}OH$ or methylaluminoxane relative to said alkyne substrate

wherein

$0 < x < 1$;

each L is independently selected from substituted or unsubstituted alkyl, alkoxy, aryl or aryloxy with 1 to 10 carbon atoms;

M is aluminium;

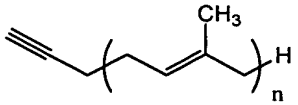
p is 1 or 2 and,

R^{20} is branched or unbranched alkyl with 1 to 15 carbon atoms, optionally substituted with 1 to 5 hydroxy substituents,

thus carboaluminating said alkyne substrate .

11. The method according to claim **10**, wherein said alkyne substrate is a terminal alkyne.

12. The method according to claim **11**, wherein said alkyne substrate has the formula:



(XIII)

wherein

n is an integer from 0 to 19.

13. The method according to claim **10,** wherein said water, $R^{20}OH$ or methylaluminoxane is present in an amount from about 2-50 mol-% relative to said alkyne substrate.

14. The method according to claim **10**, said method further comprising contacting said alkyne substrate with a carboalumination catalyst, in an amount less than one equivalent relative to said alkyne substrate.

15. The method according to claim **14**, wherein said carboalumination catalyst is used in an amount of less than 0.2 molar equivalents relative to said alkyne substrate.

16. The method according to claim **14**, wherein said carboalumination catalyst is a member selected from zirconium- and titanium-containing species.

17. The method according to claim **10**, wherein said carboalumination is conducted in a solvent or solvent mixture comprising at least one non-chlorinated solvent.

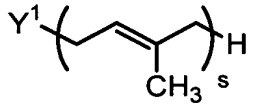
18. The method according to claim **17**, wherein said non-chlorinated solvent is a member selected from trifluoromethylbenzene and toluene.

19. The method according to claim **17**, wherein said carboalumination is conducted in trifluoromethylbenzene or toluene or mixtures thereof.

20. The method according to claim **12**, wherein said alkyne substrate is produced by:

(a) forming propyne dianion by contacting propyne with a base; and

(b) combining said propyne dianion with a compound having the formula:



(X)

wherein

Y^1 is a leaving group; and

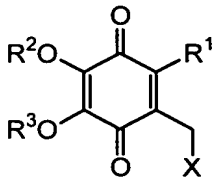
s is an integer from 1 to 19.

21. The method according to claim **20**, wherein said leaving group of Formula Y^1 is chlorine, bromine, iodine, tosylate or mesylate.

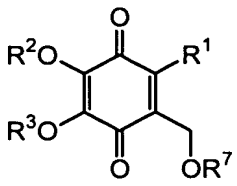
22. The method according to claim **10**, further comprising:

(b) contacting the product of step (a) in claim 10 with a compound of

Formula (VII) or (XXIV),



(VII)



(XXIV)

in which

R^1, R^2 and R^3 are independently selected from substituted or unsubstituted C_1-C_6 alkyl groups;

R^7 is selected from H, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted aryl, substituted or unsubstituted heteroaryl, substituted or unsubstituted heterocycloalkyl, SOR^9, SO_2R^9, $C(O)R^9$, $C(O)OR^9$, $P(O)OR^9OR^{10}$, $P(O)N(R^9)_2(R^{10})_2$, and $P(O)R^9R^{10}$

wherein

each R^9 and R^{10} is a member independently selected from substituted or unsubstituted alkyl, substituted or unsubstituted aryl, substituted or unsubstituted heteroaryl and substituted or unsubstituted heterocycloalkyl; and

X is a leaving group,

under conditions appropriate to couple the carboaluminated product of step (a) in claim 10 with the methylene carbon atom of the compound of Formula (VII) or (XXIV).

23. The method according to claim **22**, wherein step (b) is conducted essentially without prior purification of the product of step (a) of claim 10.

24. The method according to claim **22**, wherein in step (b) a compound of Formula **13** is contacted with a product of step (a) in claim 10.

25. The method according to claim **24**, wherein a compound **13** is used in form of a mixture further comprising a compound of formula **14**.

26. The method according to claim **25**, wherein the mixture comprising

compounds **13** and **14** is used after filtration through an adsorbent medium.

27. The method according to claim **26**, wherein said adsorbent medium is alumina.

28. The method according to claim **12**,

said method comprising:

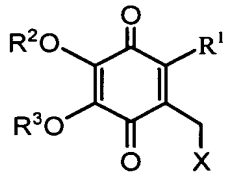
(a) contacting a reaction mixture comprising said alkyne substrate of Formula (XIII) with an adsorbent medium; and

(b) eluting said alkyne substrate from said adsorbent medium and collecting said alkyne substrate as a single fraction; and

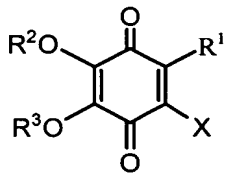
(c) submitting the product from step (b) to a carboalumination reaction essentially without further purification,

thus carboaluminating said alkyne substrate.

29. A method of separating components of a mixture, said components comprising a substituted-methylene quinone and a quinone having the formulae:



; and



(VII) (XXXIX),

respectively

in which

R^1, R^2 and R^3 are independently selected from substituted or unsubstituted C_1-C_6 alkyl groups;

X is a leaving group;

said method comprising:

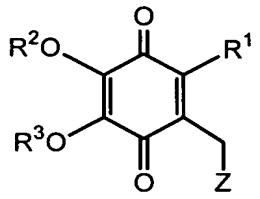
(a) contacting the mixture with a reactive species that selectively binds through a heteroatom to the methylene carbon of said substituted-methylene quinone, displacing said leaving group, producing a charged substituted-methylene quinone; and

(b) separating said charged substituted-methylene quinone from said quinone,

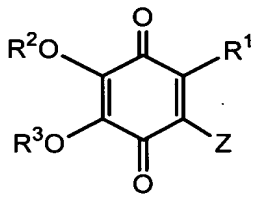
thereby separating said mixture.

30. The method according to claim **29**, further comprising, contacting the substituted-methylene quinone with a vinylalane, under conditions appropriate to form a ubiquinone.

31. A method of separating a substituted methylene quinone and a halo-quinone having the formulae:



; and



13 **14**

respectively

in which

R^1, R^2 and R^3 are independently selected from substituted or unsubstituted C_1-C_6 alkyl groups;

Z is a halogen;

said method comprising:

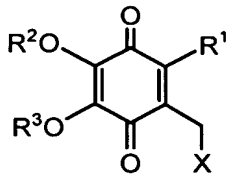
(a) contacting said mixture with a reducing agent that selectively reduces the halo-quinone to a halo-hydroquinone;

(b) contacting the product of step (a) with a base, forming an anion of said halo-hydroquinone; and

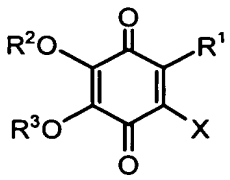
(c) separating said anion from said substituted methylene quinone, thereby separating said mixture.

32. The method according to claim **31**, further comprising, contacting the said substituted methylene quinone with a vinylalane, under conditions appropriate to form a ubiquinone.

33. A method of separating a mixture of a substituted-methylene quinone and a quinone having the formulae:



; and



(VII), (XXXIX)

respectively

in which

R^1, R^2 and R^3 are independently selected from substituted or unsubstituted C_1-C_6 alkyl groups;

X is a leaving group;

said method comprising:

(a) contacting the mixture with a reactive species that selectively binds through a heteroatom to the methylene carbon of said substituted-methylene quinone, displacing said leaving group;

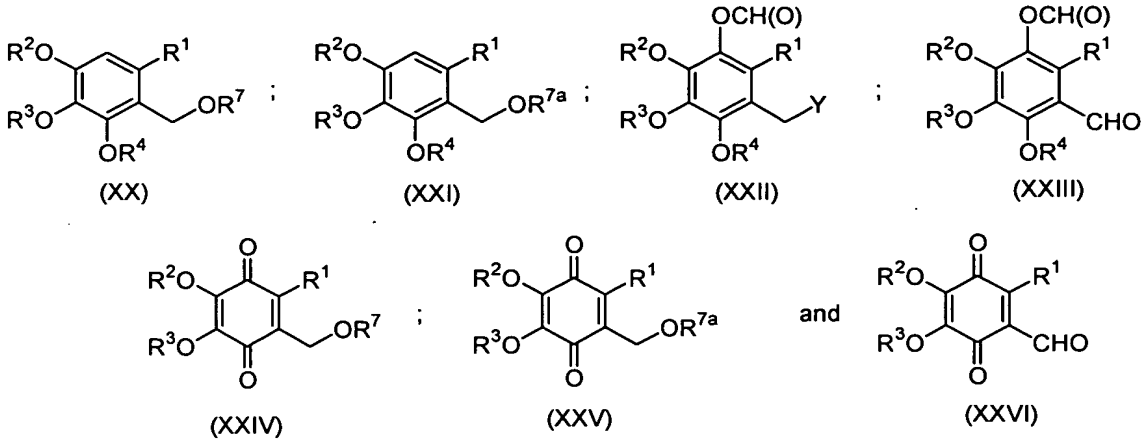
(b) separating the product of (a) from said quinone, thereby separating said mixture.

34. The method according to claim **33**, wherein said reactive species is a substituted or unsubstituted C_1-C_{20} carboxylate.

35. The method according to claim **33**, wherein said separating is by chromatography.

36. The method according to claim **33**, further comprising, contacting the substituted-methylene quinone with a vinylalane, under conditions appropriate to form a ubiquinone.

37. A compound having a structure that is a member selected from:



in which

R^1, R^2 and R^3 are independently selected from substituted or unsubstituted C_1-C_6 alkyl groups;

R^4 is a member selected from H, substituted or unsubstituted alkyl, a metal ion and a protecting group;

R^7 is selected from H, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted aryl, substituted or unsubstituted heteroaryl, substituted or unsubstituted heterocycloalkyl, SOR^9, SO_2R^9, $C(O)R^9$, $C(O)OR^9$, $P(O)OR^9OR^{10}$, $P(O)N(R^9)_2(R^{10})_2$, and $P(O)R^9R^{10}$ wherein

each R^9 and R^{10} is a member independently selected from substituted or unsubstituted alkyl, substituted or unsubstituted aryl, substituted or unsubstituted heteroaryl and substituted or unsubstituted heterocycloalkyl; and

Y is OR^{11}, SR^{11}, $NR^{11}R^{12}$, or a leaving group;

R^{11} and R^{12} are independently selected from H, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted aryl, substituted or unsubstituted heteroaryl and substituted or unsubstituted heterocycloalkyl; and

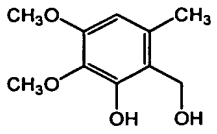
R^{7a}, together with the oxygen to which it attached, is a leaving group.

38. The compound according to claim **37**, wherein R^{7a} is a member selected from SOR^9, SO_2R^9, $C(O)R^9$, $C(O)OR^9$, $P(O)OR^9OR^{10}$, $P(O)N(R^9)_2(R^{10})_2$, and $P(O)R^9R^{10}$

wherein

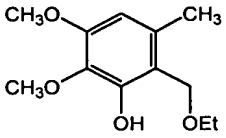
each R^9 and R^{10} is a member independently selected from substituted or unsubstituted alkyl, substituted or unsubstituted aryl, substituted or unsubstituted heteroaryl and substituted or unsubstituted heterocycloalkyl.

39. The compound according to claim **37**, having the formula:



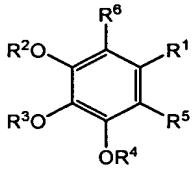
(4).

40. The compound according to claim **37**, having the formula:



(6).

41. A compound having the formula:



(I)

wherein

R^1, R^2 and R^3 are members independently selected from substituted or unsubstituted C_1-C_6 alkyl groups;

R^4 is a member selected from hydrogen, substituted or unsubstituted alkyl, and protecting groups;

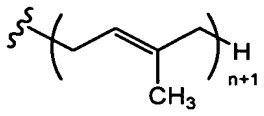
R^5 is a member selected from branched, unsaturated alkyl, CH(O), CH_2Y wherein

Y is OR^7, SR^7, NR^7R^8 or a leaving group wherein

R^7 and R^8 are members independently selected from H, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted aryl, substituted or unsubstituted heteroaryl and substituted or unsubstituted heterocycloalkyl; and

R^6 is a member selected from OH and OCH(O).

42. The compound according to claim **41**, wherein R^5 is a moiety having the formula:

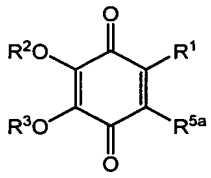


(VIII)

wherein

n is an integer from 0 to 19.

43. The compound according to claim **37**, having the formula:



(II)

wherein

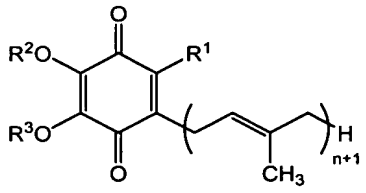
R^1, R^2 and R^3 are members independently selected from substituted or unsubstituted C_1-C_6 alkyl groups; and

R^{5a} is a member selected from CH(O) and CH_2OR^{7a}

wherein

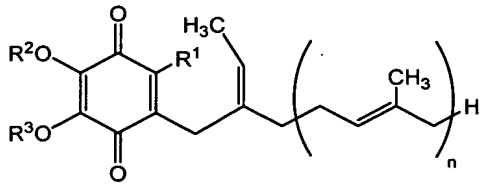
R^{7a} is selected from H and substituted or unsubstituted alkyl.

44. A mixture comprising:



(III)

and



(IX)

wherein

R^1, R^2 and R^3 are members independently selected from substituted or unsubstituted C_1-C_6 alkyl groups; and

n is an integer from 0 to 19.

45. A mixture according to claim **44**, wherein n is 9.

46. A mixture according to claim **44**, wherein R^1, R^2 and R^3 are methyl.

47. A mixture according to claim **44**, in which the molar ratio of the compound of Formula (III) to the compound of Formula (IX) is at least 8 to 1.